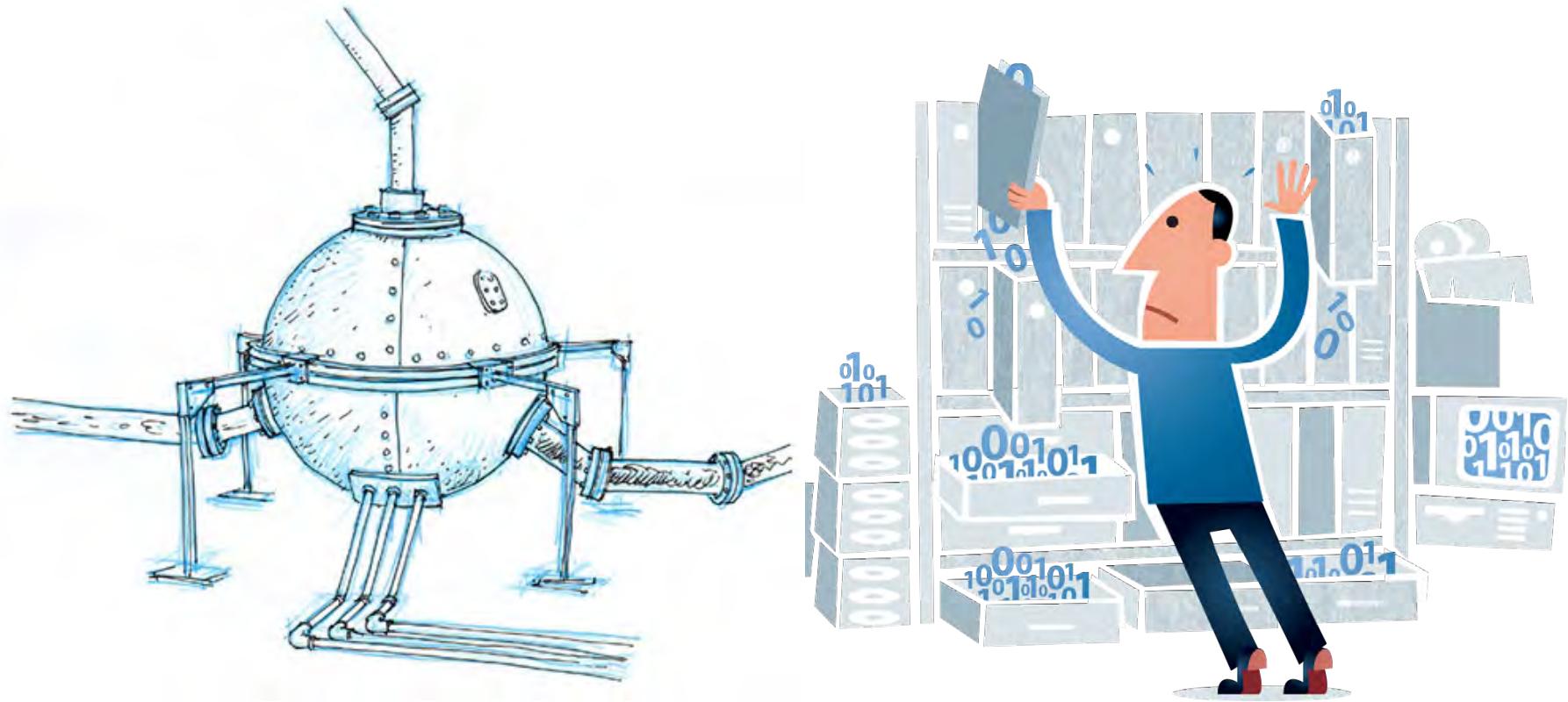
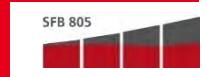
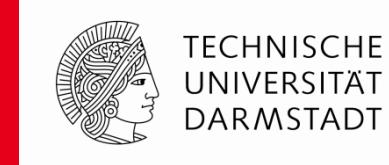


# Special aspects of experimental research in engineering sciences

and consequential demands for research data management

Nils Preuß, Prof. Dr.-Ing. Peter F. Pelz



# Experimental research @ FST



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1. generic experiments, physical understanding

*thermo-fluids & interfaces*

2. component testing

*validation of systems and component models*

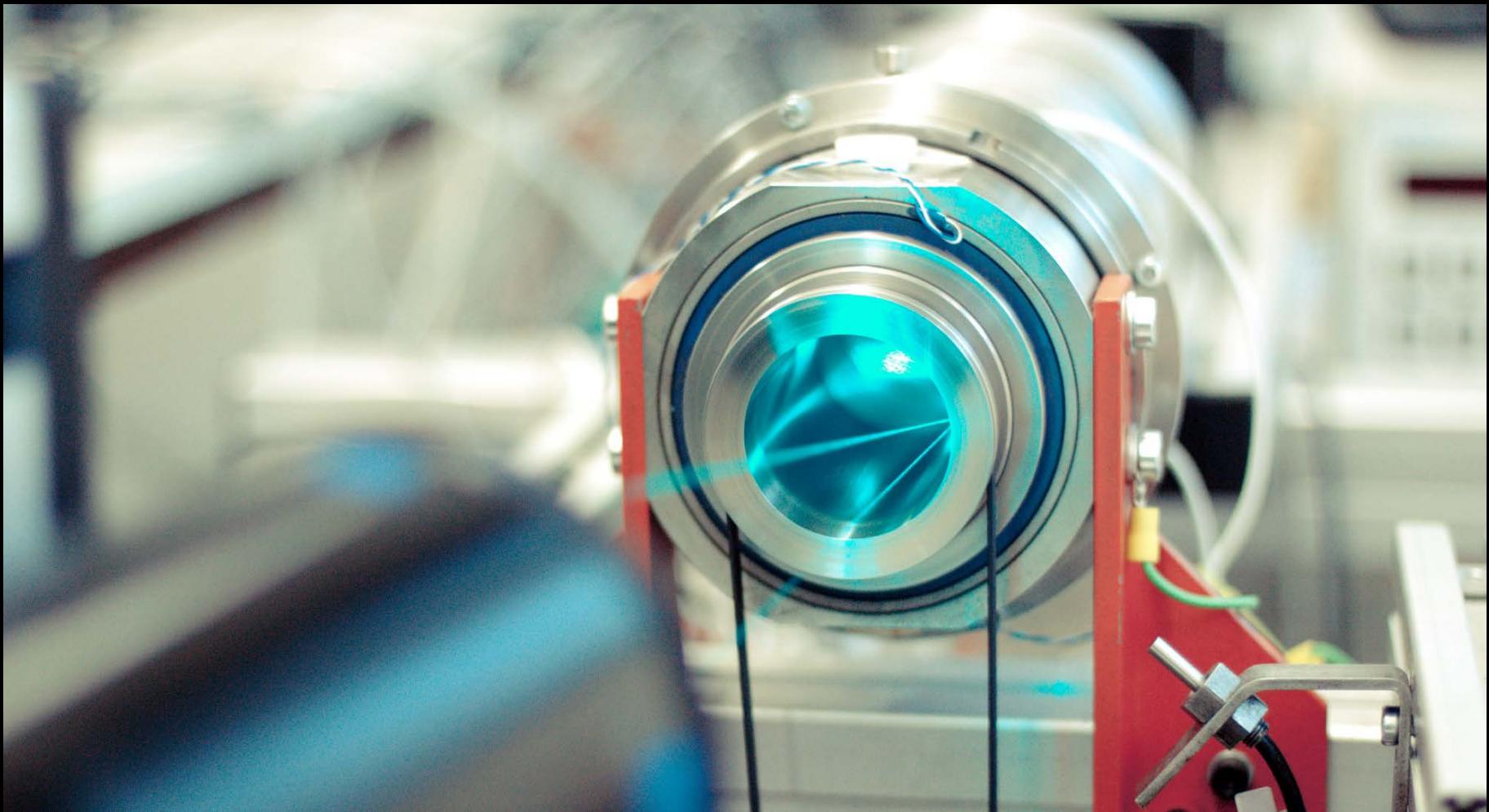
3. mechatronic systems

*Hardware-in-the-Loop validation of closed-loop controlled systems*

4. urbanization

*validation of slum development models against remote sensing data*

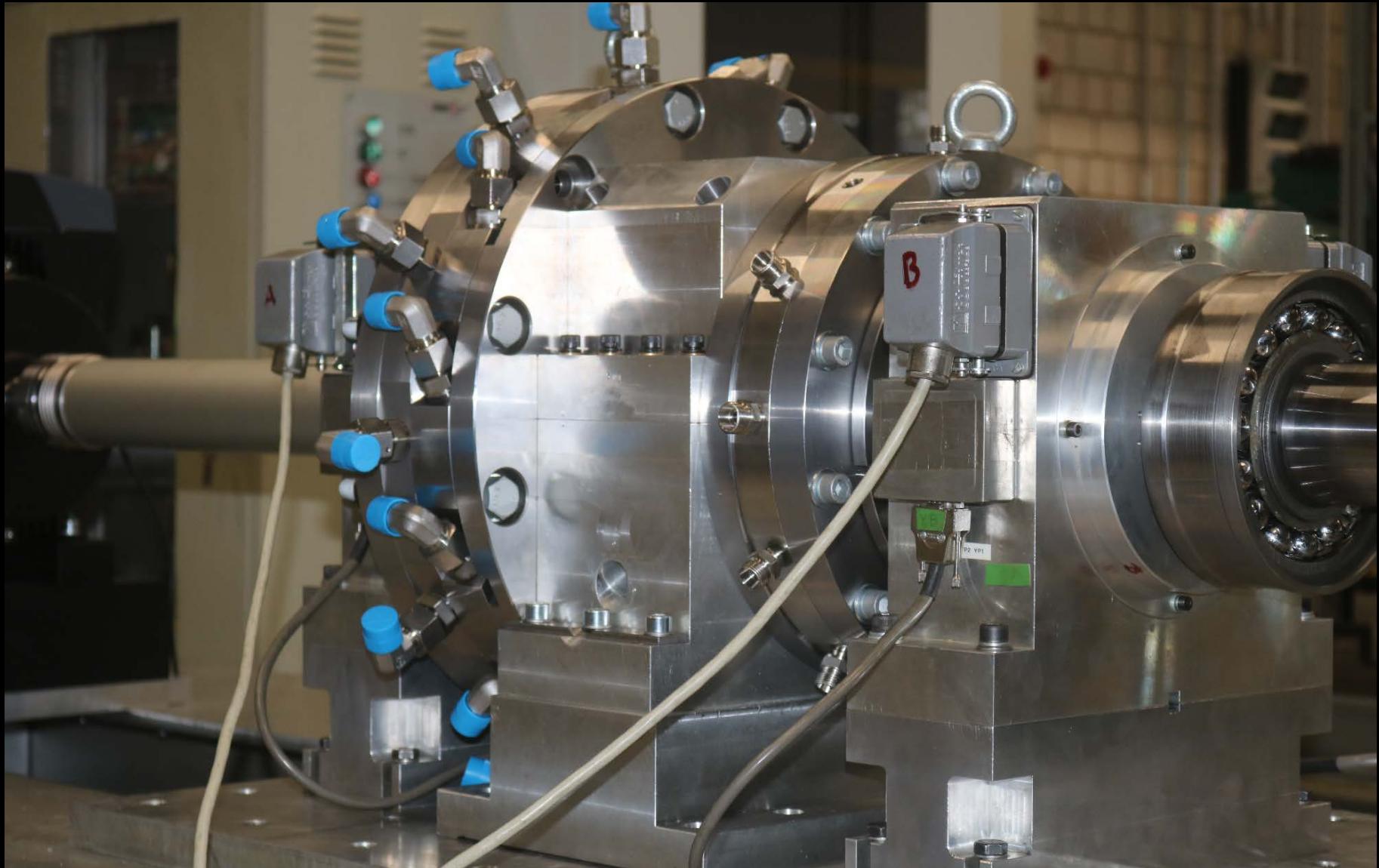
# 1. generic experiments, physical understanding *thermo-fluids & interfaces*



Cloos, F. J.; Stapp, D.; Pelz, P. F.:  
Swirl boundary layer and flow separation at the inlet of a rotating pipe;  
Journal of Fluid Mechanics  
(2017)

# 1. generic experiments, physical understanding

*thermo-fluids & interfaces*



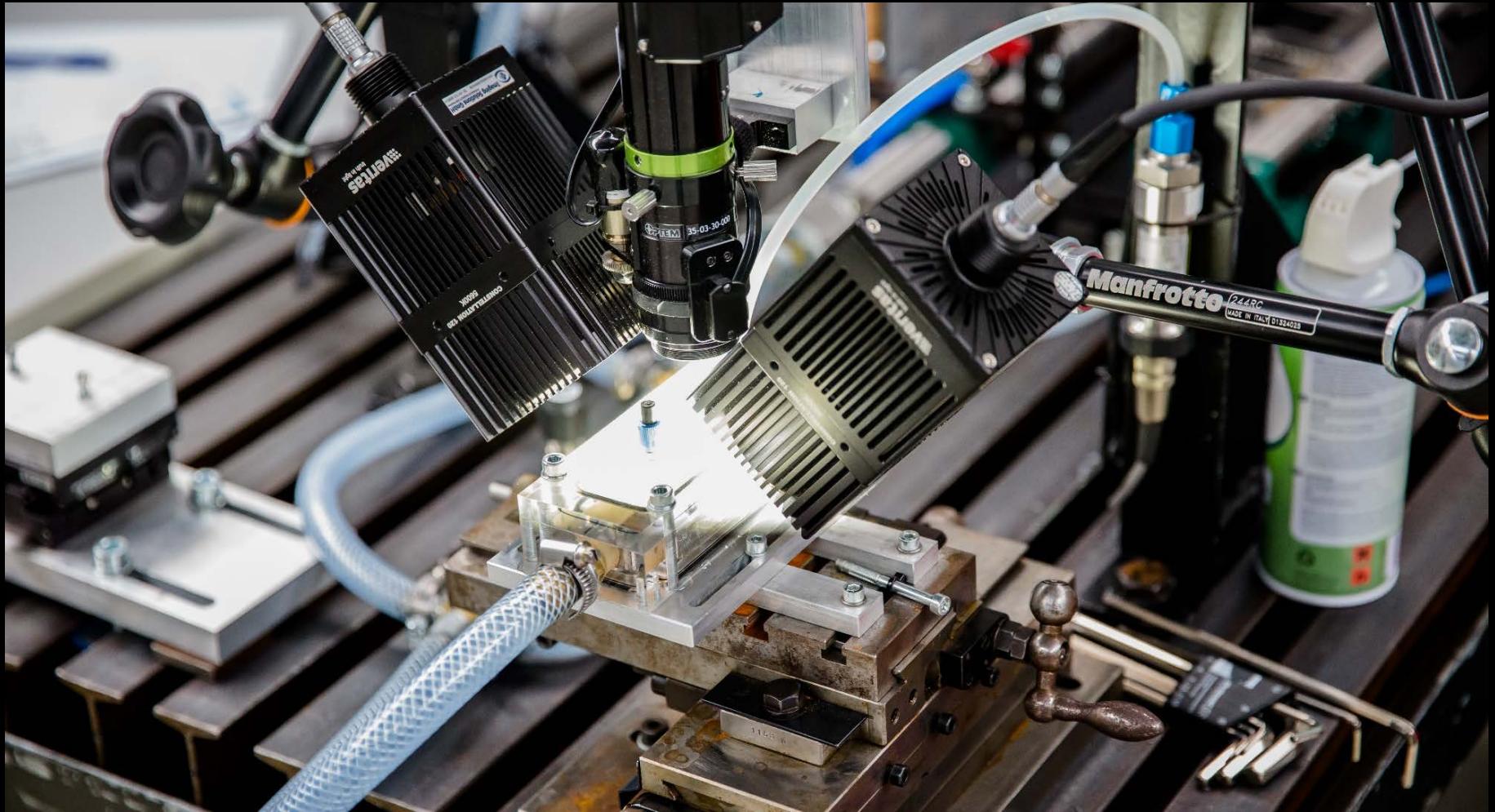
# 1. generic experiments, physical understanding *thermo-fluids & interfaces*



Recording 5000 fps  
Video 30 fps

Pelz, P. F.; Keil, T.; Groß, T. F.:  
*The Transition from Sheet to Cloud Cavitation;*  
Journal of Fluid Mechanics  
(2017)

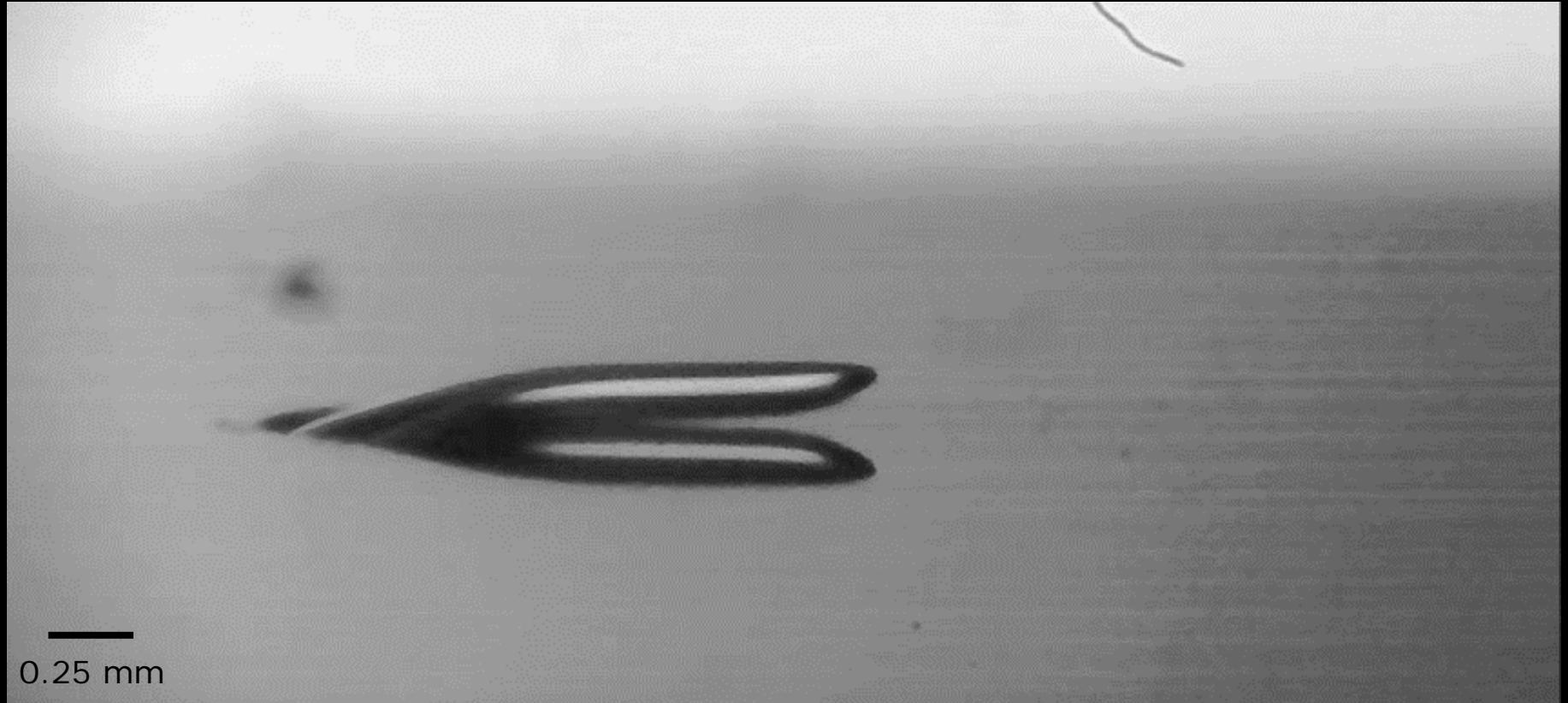
# 1. generic experiments, physical understanding *thermo-fluids & interfaces*



Groß, T. F. et. al.:

*Bubble nucleation from micro crevices in a shear flow. Subtitle: Experimental determination of nucleation rates and surface nuclei growth;*  
Experiments in Fluids (2017)

# 1. generic experiments, physical understanding *thermo-fluids & interfaces*



Pelz, P. F.; Keil, T.; Groß, T. F.:  
*The Transition from Sheet to Cloud Cavitation;*  
Journal of Fluid Mechanics  
(2017)

Recording 1000 fps  
Video 15 fps

# 1. generic experiments, physical understanding

## *thermo-fluids & interfaces*

Pelz, P. F.; Corneli, T.  
*The activation energy for wall slip;*  
Physical Review Letters  
(under review 2017)

## 2. component testing

*validation of systems and component models*



Karstadt et. al.:

The influence of tip clearance on the acoustic and aerodynamic characteristic of fans;  
ASME Turbo Expo  
(2010)

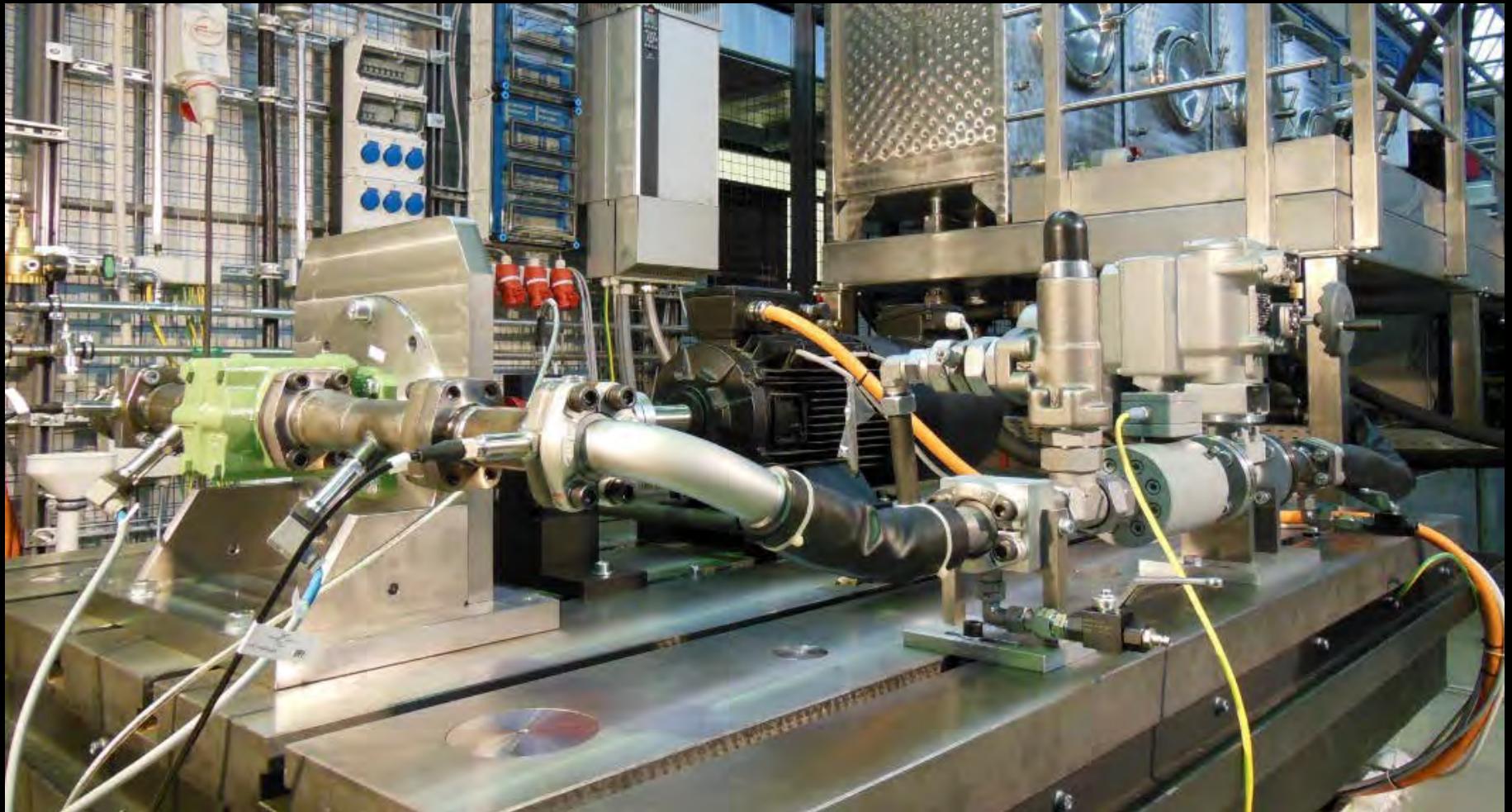
## 2. component testing, BMWi

*validation of systems and component models*



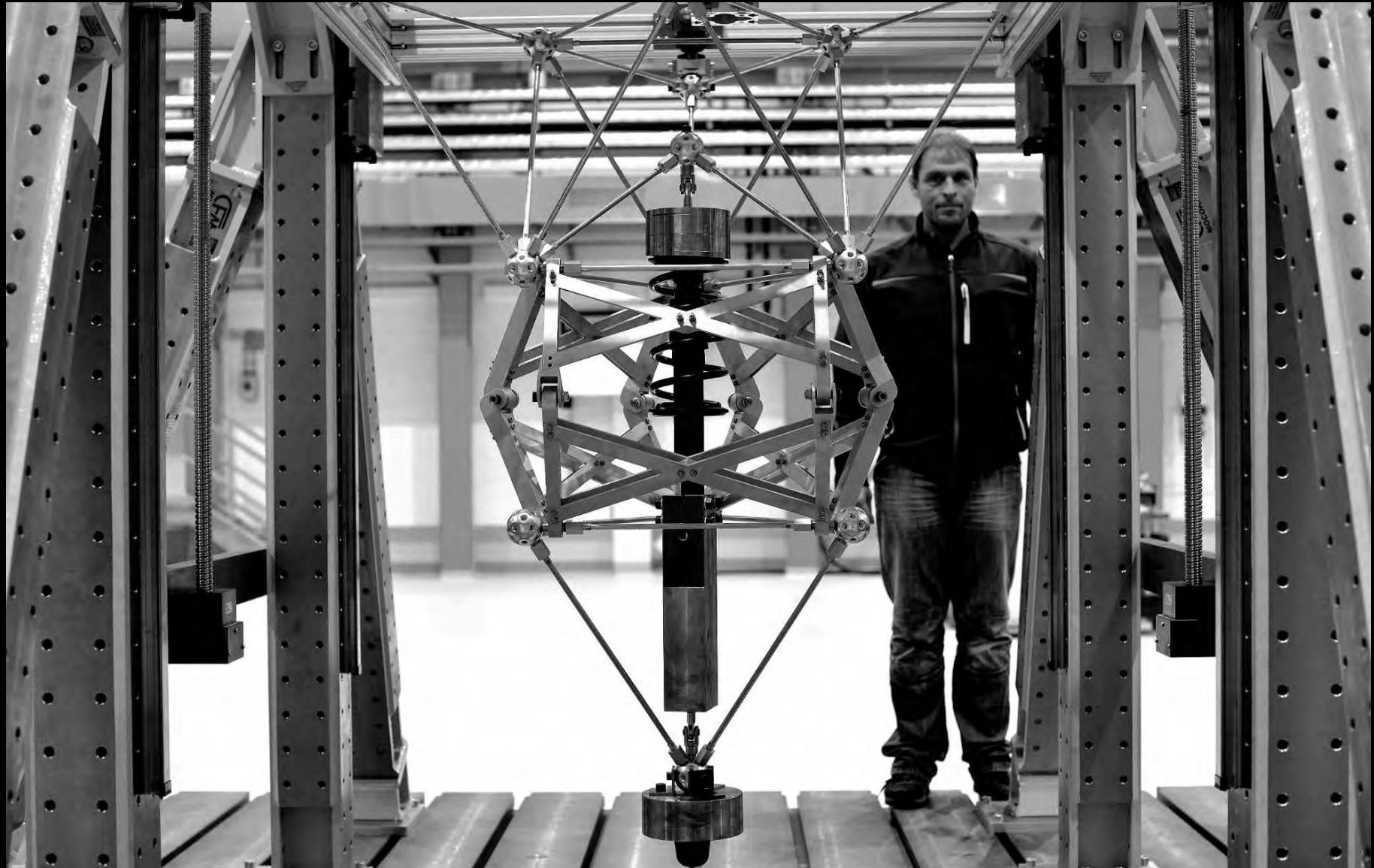
## 2. component testing, BMWi

*validation of systems and component models*



### 3. mechatronic systems, SFB805

*Hardware-in-the-Loop validation of closed-loop controlled systems*



### 3. mechatronic systems, SFB805 & ETIT

*Hardware-in-the-Loop validation of closed-loop controlled systems*



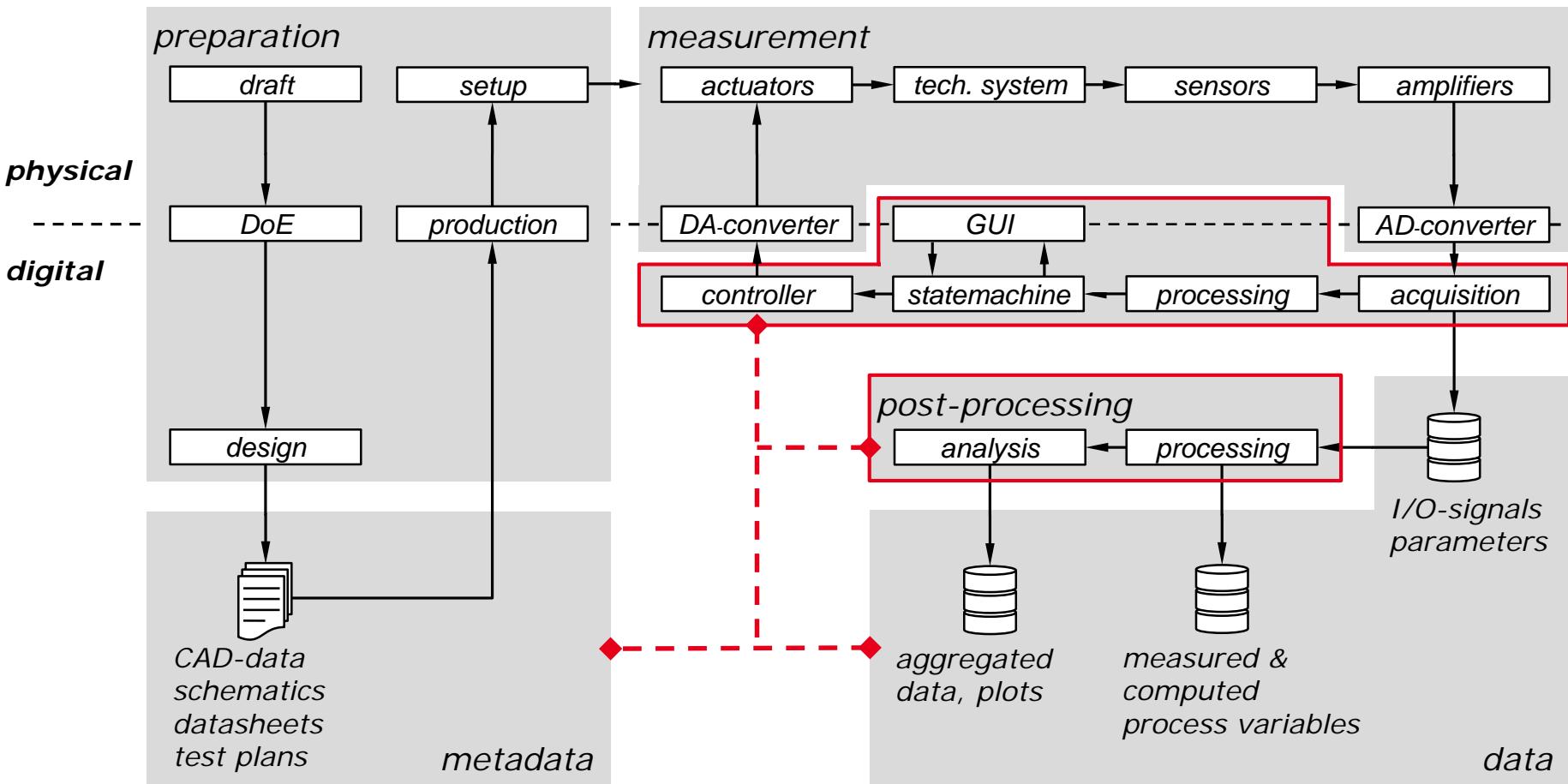
## 4. urbanization, jointly with DLR

*validation of slum development models against remote sensing data*



Friesen J.; Taubenböck, H.; Wurm, M.; Pelz, P. F.:  
The similar size of slums;  
Habitat International  
(2018)

# The general research environment in engineering sciences



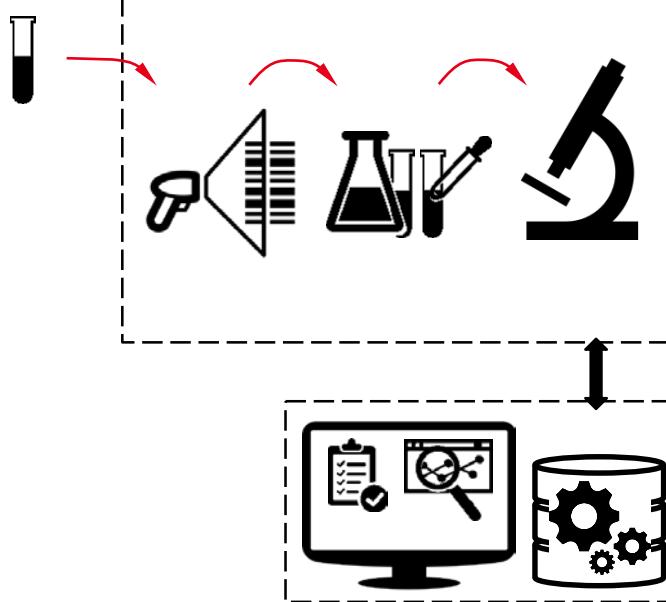
# Why existing software products are not applicable



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*bio, chemistry  
experiments*

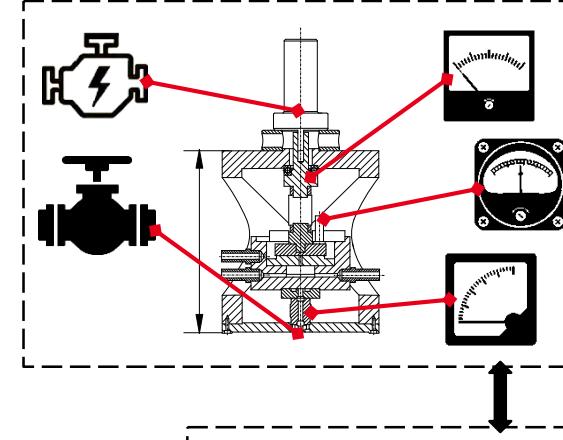
*highly standardized  
instrumentation*



*LIMS, ELN, ...*

*engineering  
experiments*

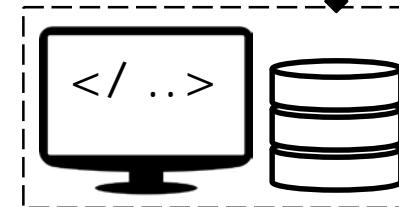
*continuously evolving,  
one of a kind system*



*objective  
is  
changing*

+

*unit under test  
is part of the  
system*



*evolving custom code*

# Why existing software products are not applicable



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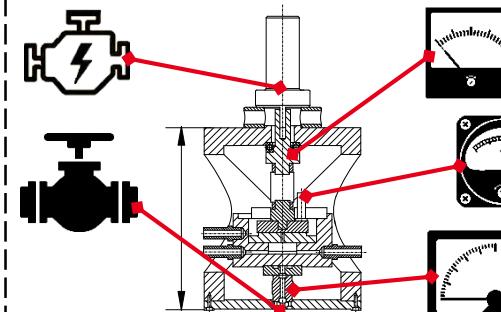
1. broad research spectrum
2. high variety of data
3. confidentiality dependent on funding (DFG – BMWI)



LIMS, ELN, ...

*engineering experiments*

*continuously evolving,  
one of a kind system*



*objective  
is  
changing*

+

*unit under test  
is part of the  
system*



*evolving custom code*

# A general purpose file format for heterogeneous & evolving data



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1. no established standards that are flexible enough
2. large variety of formats and schemas
3. prevalent lack of uniform or standard metadata  
→ prevents publication!

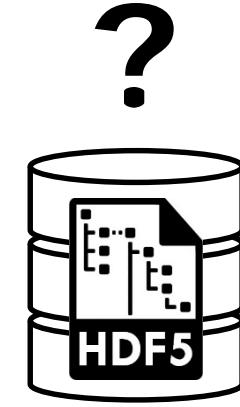


# A general purpose file format for heterogeneous & evolving data

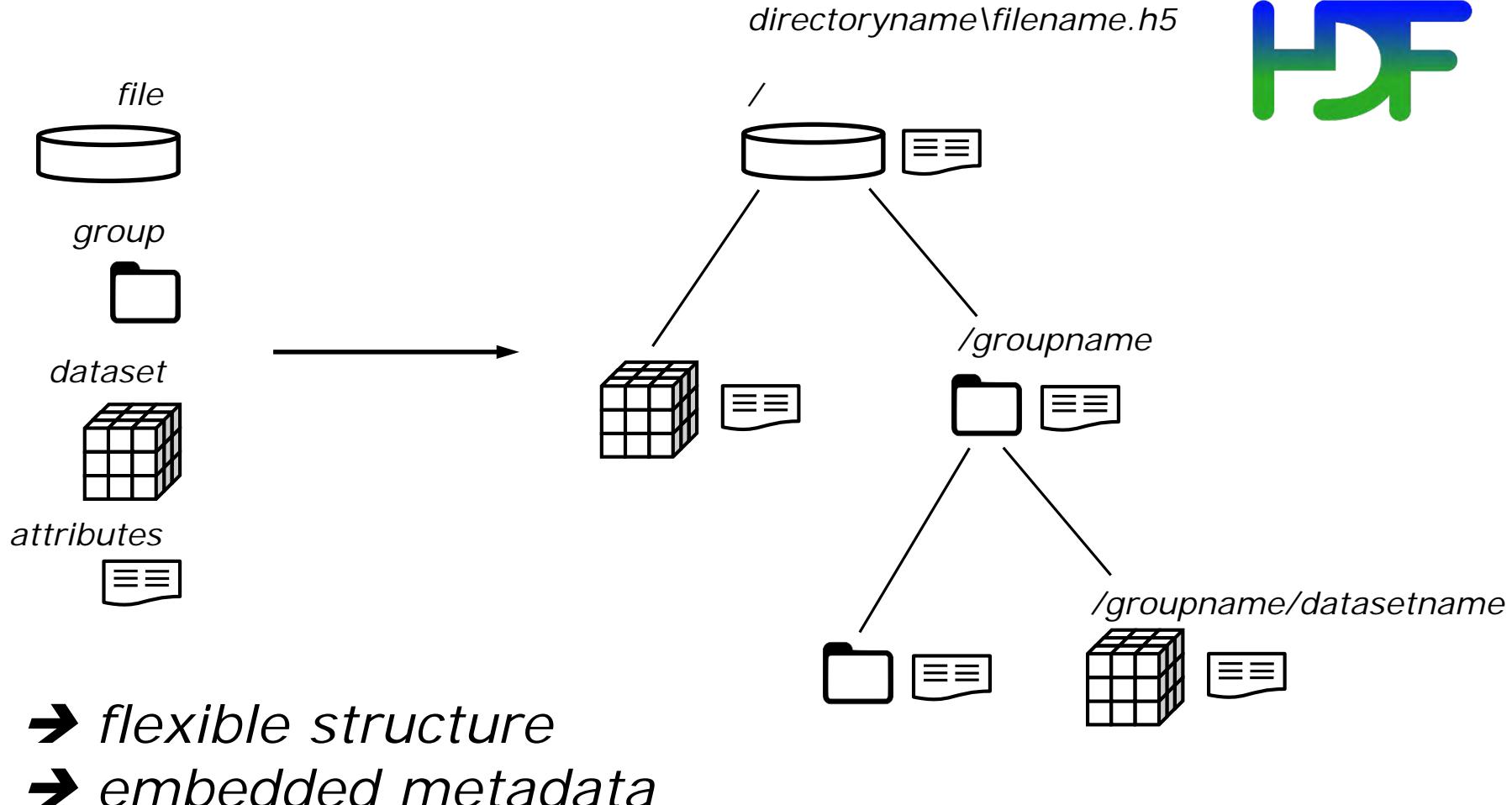


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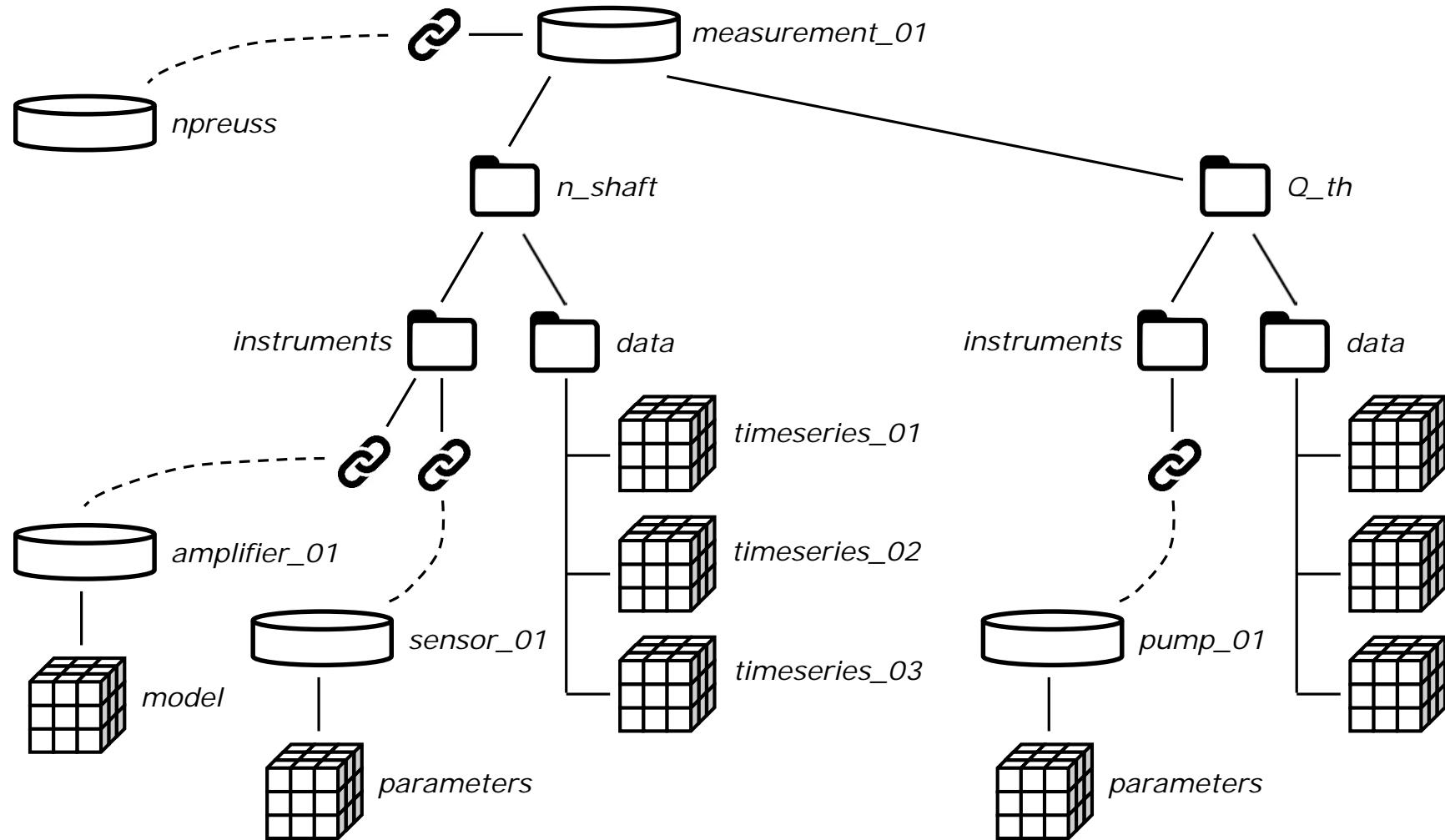
- i. flexible data structure
- ii. self descriptive
- iii. interoperability
- iv. independence
- v. simple interface



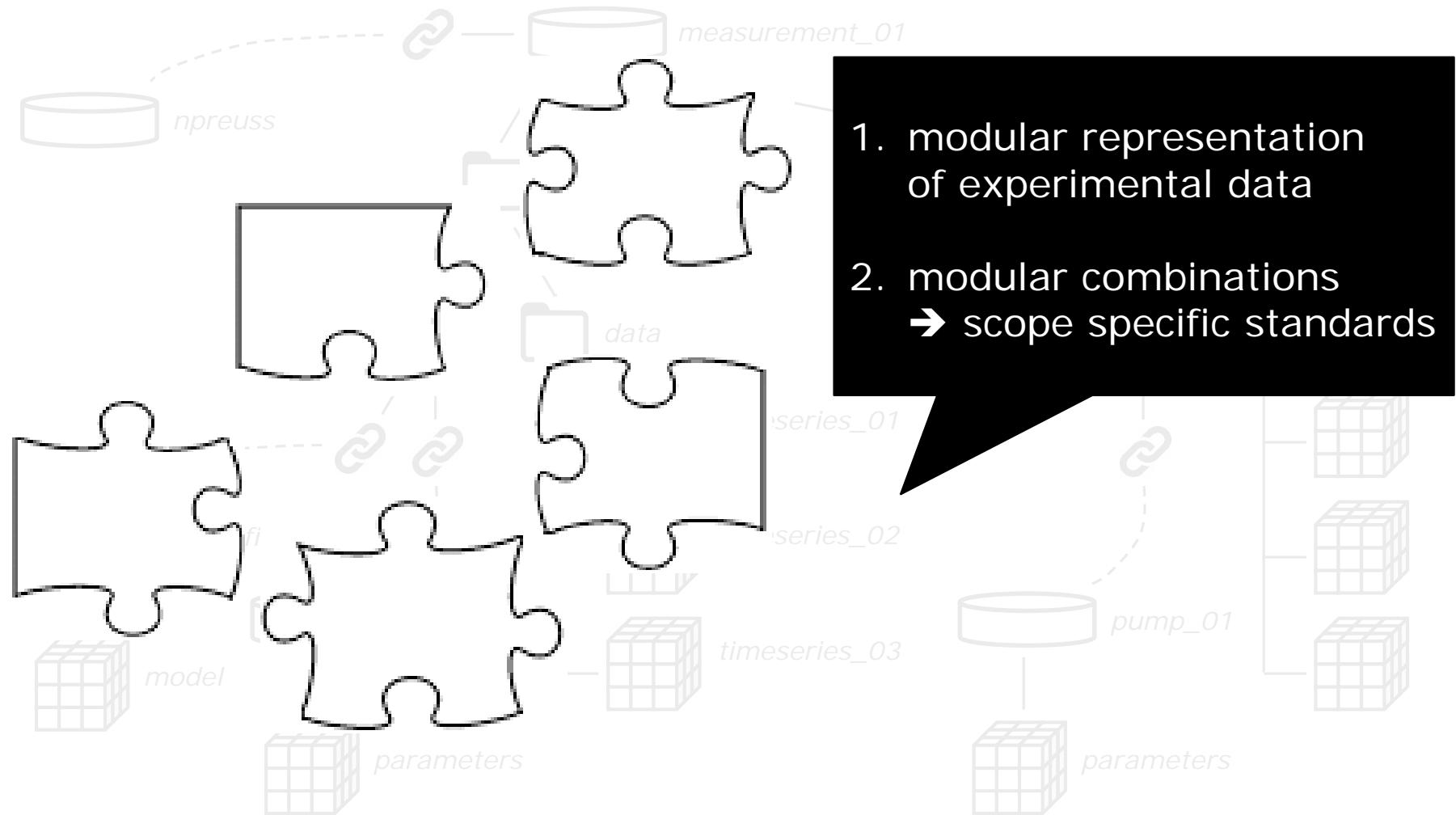
# The HDF5 abstract data model



# Domain specific HDF5 data model



# Domain specific HDF5 data model

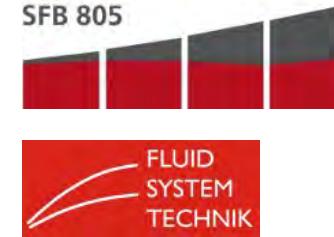


# Realization & validation



## 1. SFB 805

- SFB demonstrator
- all FST test rigs



## 2. SFB 1194

IDD Dörsam



## 3. DLR

- Berlin, turbomachinery  
Enghardt
- Oberpfaffenhofen,  
remote sensing  
Taubenböck, Wurm

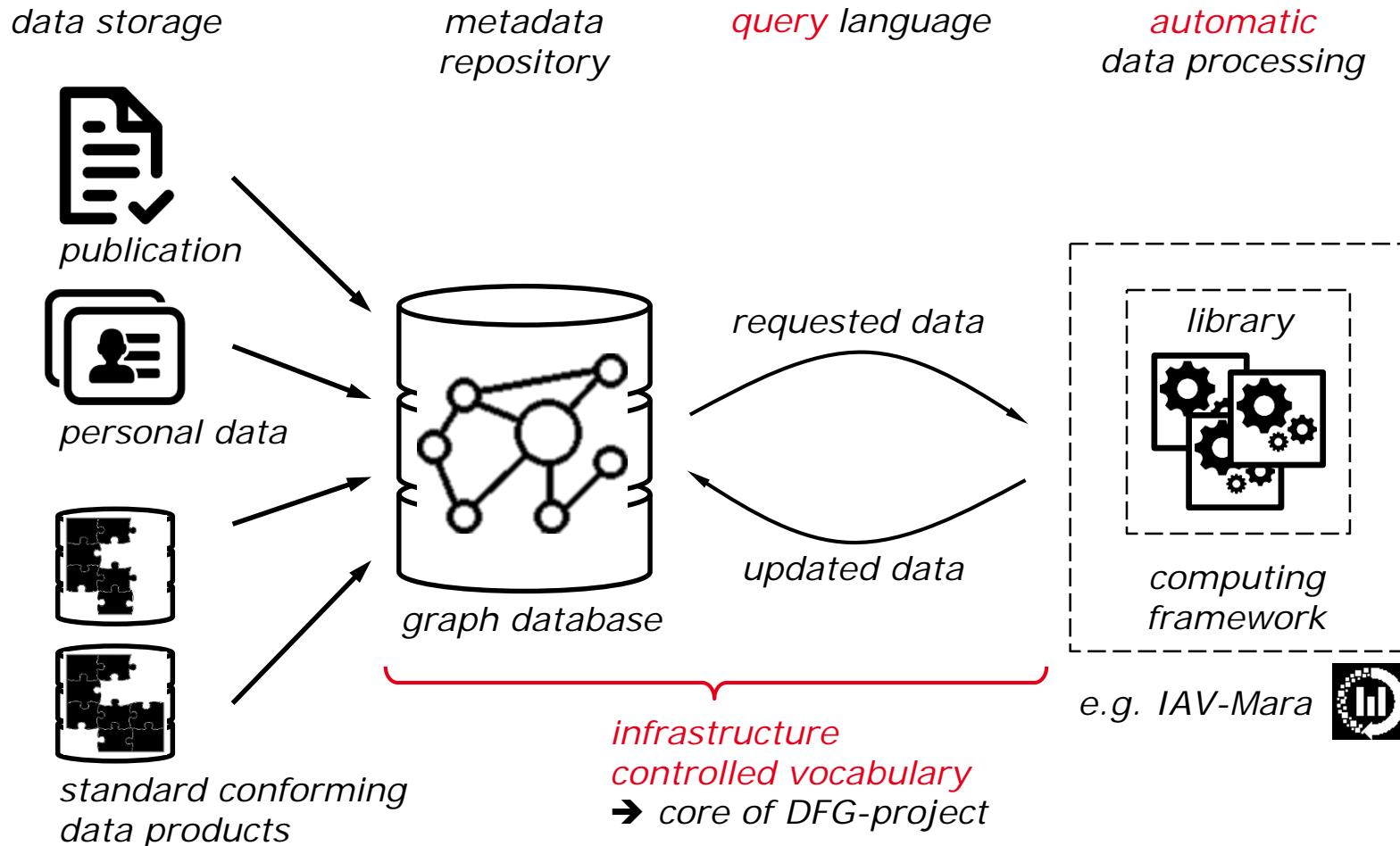


## 4. Joint DFG-project ULB, FST, ITC, WZL in preparation

# ULB/FST/ITC/WZL-project in preparation data querying and analysis automation



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# Current data access methods



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(i) everyday life



(ii) scientific publications

ScienceDirect

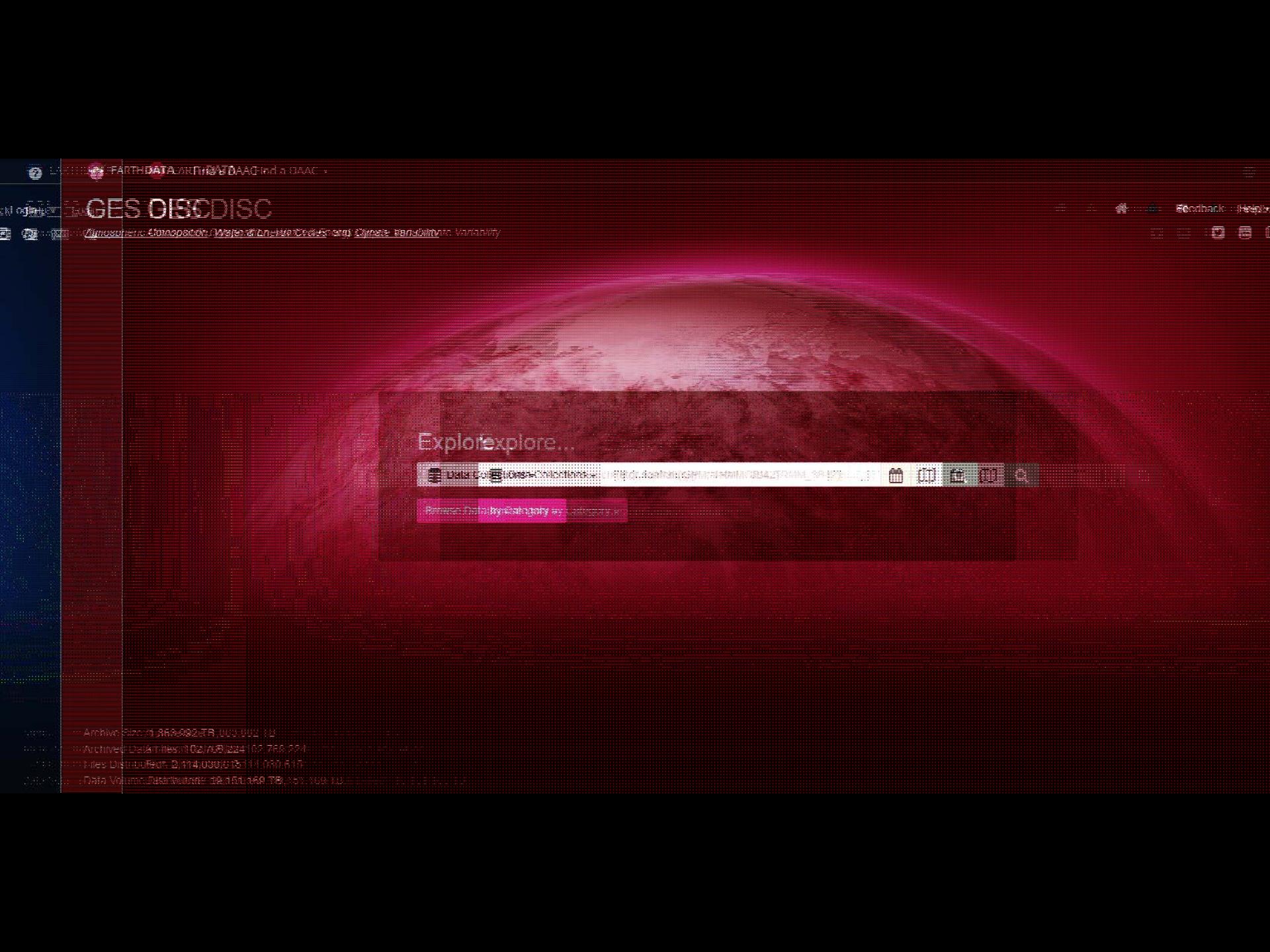


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(iii) scientific data, projects ...







GES DISC Data Explorer

# GES DISC

Discover · Explore · Download · Create · Share · Contribute · Feedback · Help

Explore...

Basic Search

Browse Data by Category

Advanced Search

Search Catalog

Archived Data: 70,359,892 TR, 303,002 TD, 1,000,000 TDF  
Archived Data Files: 102,719,284 102,708,724  
Files Distributed: 3,114,000/618,111,000/5,177  
Data Volume: 10,151,169 TB, 325,309 TB

# Future data access methods



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RDM Infrastructure ...

1. provides search engine
2. links data to publications, facilities, researchers ...
3. allows collaboration across facilities
4. lets researchers manage access permissions
5. enables community to enforce quality standards

researchers can gain credibility via text **AND** data publications!

ScienceDirect



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